Alaska Outer Continental Shelf

OCS EIS/EA
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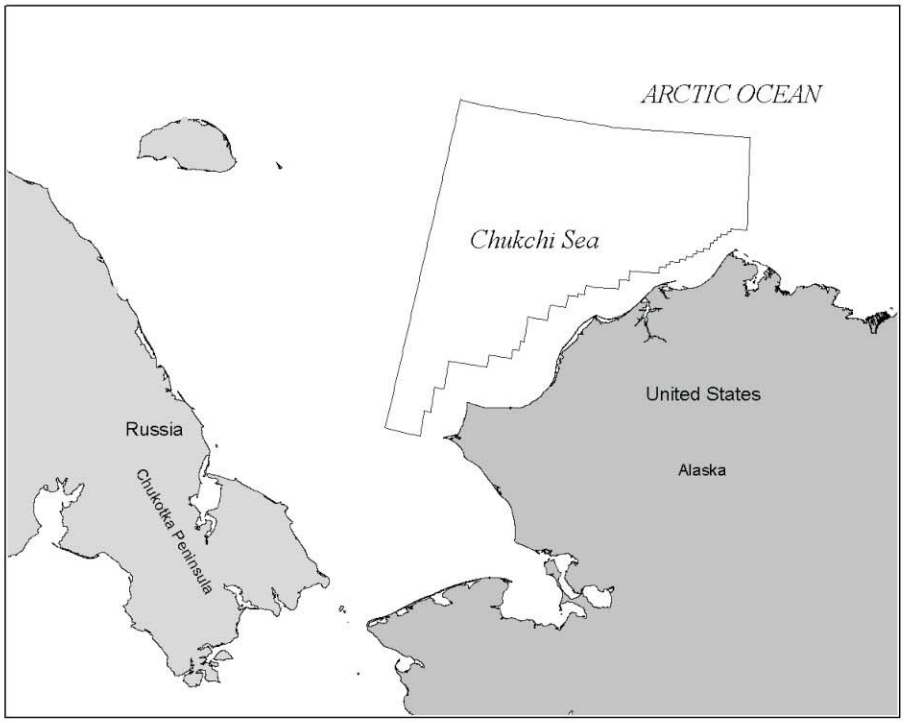
Chukchi Sea Planning Area

Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea

Draft Environmental
Impact Statement

Volume II
Tables, Figures, Maps, and Appendices



MMS
U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

Alaska Outer Continental Shelf

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Chukchi Sea Planning Area
Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea

Final Environmental Impact Statement

Volume II
(Tables, Figures, Maps, and Appendices)

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National Marine Fisheries Service

U.S. Department of the Interior
Minerals Management Service
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Appendix D

Summary: Analysis of Seismic Survey Mitigation Alternatives

Appendix D. Summary: Analysis of Seismic Survey Mitigation Alternatives.

The following mitigation alternatives related to conducting seismic surveys were analyzed as part of the "*Final Programmatic Environmental Assessment (PEA), Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006*," dated June 2006 (OCS EIS/EA MMS 2006-038):

> **Alternative 1.** No seismic-survey permits issued for geophysical exploration activities (No Action). *(Referenced in Chukchi 193 DEIS as Seismic Survey Mitigation Alternative 1)*
>
> **Alternative 2.** Seismic surveys for geophysical-exploration activities would be permitted with existing Alaska OCS G&G exploration stipulations and guidelines. *(Referenced in Chukchi 193 DEIS as Seismic Survey Mitigation Alternative 2)*
>
> **Alternative 3.** Seismic surveys for geophysical exploration activities would be permitted incorporating existing Alaska OCS G&G exploration stipulations and guidelines and additional protective measures for marine mammals, including a 120-decibel-(dB)-specified exclusion zone. *(Referenced in Chukchi 193 DEIS as Seismic Survey Mitigation Alternative 3)*
>
> **Alternative 4.** Seismic surveys for geophysical-exploration activities would be permitted incorporating existing Alaska OCS G&G exploration stipulations and guidelines and additional protective measures for marine mammals, including a 160-dB-specified exclusion zone. *(Referenced in Chukchi 193 DEIS as Seismic Survey Mitigation Alternative 4)*
>
> **Alternative 5.** Seismic surveys for geophysical-exploration activities would be permitted incorporating existing Alaska OCS G&G exploration stipulations and guidelines and additional protective measures for marine mammals, including 160-dB- and 120-dB-specified exclusion zones. *(Referenced in Chukchi 193 DEIS as Seismic Survey Mitigation Alternative 5)*
>
> **Alternative 6.** Seismic surveys for geophysical-exploration activities would be permitted incorporating existing Alaska OCS G&G exploration stipulations and guidelines and additional protective measures for marine mammals, including a 180/190-dB-specified exclusion zone. *(Referenced in Chukchi 193 DEIS as Seismic Survey Mitigation Alternative 6)*

The sections that follow are summarizing excerpts from the PEA which described the potential impacts of Alternatives 1, 3, 4, 5, and 6. Alternative 2 was dropped from detailed analysis in the PEA because of its potential to cause unavoidable significant impacts. See the PEA for a more detailed and thorough description and discussion of the potential impacts of conducting seismic surveys and the mitigation measures proposed to protect the biological resources of the Arctic Ocean.

Fish/Fishery Resources and Essential Fish Habitat (EFH)

Alternative 1 (No Action) poses no adverse impacts to fish/fishery resources or EFH.

Alternatives 3 through 6 would have adverse but not significant impacts on fish/fishery resources and EFH. The analysis in the final PEA notes specific issues that were afforded additional assessment given their importance to fish survival and reproduction and human uses, including impacts to migration and spawning, rare species, subsistence fishing, and operation of coincidental multiple seismic surveys. However, based on the above assessment, MMS concludes that the potential for impacts to these issues (e.g., migration, spawning, rare species, and subsistence fishing) also is adverse but not significant.

Alternatives 3 through 6 all equally employ mitigation measures to avoid or limit the potential for impacts to fish resources and EFH. As these measures apply across Alternatives 3 through 6, there remains little difference across the various alternatives as to the degree of impacts for this species group and related issues. In theory, the alternatives with the more restrictive exclusion zones for marine mammals (Alternatives 3 and 5) would provide more protection for marine fish and invertebrate species if seismic

survey shutdown were to occur, but again this would be considered only incrementally more protective for fish, invertebrates and related issues.

The following mitigation measures are specifically designed to limit potential impacts to migration, spawning, rare species, subsistence fishing, and operation of multiple seismic surveys:

- Seismic cables and airgun arrays shall not be towed in the vicinity of fragile biocenoses, unless MMS determines the proposed operations can be conducted without damage to the fragile biocenoses.

- Based on the information provided by MMS on the known locations of fragile biocenoses in the Chukchi and Beaufort seas, the applicant shall clearly explain to what distance their operations will avoid fragile biocenoses and how they will avoid damaging fragile biocenoses.

- Permittees shall report to MMS if damage to fragile biocenoses occurs as a result of their operations. Additionally, Permittees shall notify MMS if they detect any fragile biocenoses otherwise not documented in their permit application.

- Vessels shall not anchor in the vicinity of any documented fragile biocenoses (e.g., the Boulder Patch, natural gardens of coral/sponge or macroalgae [e.g., kelp beds]), unless an emergency situation involving human safety specifically exists and there are no other feasible sites to anchor at the time.

Threatened and Endangered (T&E) Species

T&E Marine Birds.

Alternative 1 (No Action) would mean that spectacled and Steller's eiders and Kittlitz's murrelets in the Beaufort and Chukchi seas would not be exposed to disturbance and noise from seismic vessels and associated seismic activities.

The most likely effects of Alternatives 3, 4, 5, and 6 involve disturbance and bird/vessel collisions. Eiders will either dive or fly in response to a disturbance. All the alternatives implement monitoring a marine mammal-exclusion zone. Mitigation measures for marine mammals likely necessitate the use of high-intensity lights at night and during inclement weather to search for marine mammals in the vessel path. Seismic surveys would cease when the marine mammal-exclusion zone could not be effectively monitored, but the high-intensity lights could remain on to search for marine mammals. The zone is monitored using observers that are onboard and/or in aircraft, and would need the use of high-intensity lighting to maintain vigilance for marine mammals when the surveys are being conducted during periods of darkness or poor visibility (e.g., during rain or fog). Use of high-intensity lighting would be independent of the size of the exclusion zone, as these lights would be useful only in areas closest to the seismic-survey vessel.

In the Chukchi Sea, spectacled eiders molt in Ledyard Bay, an area designated as critical habitat. Males and/or females are present in this area from early July through the middle of October or possibly later. As day-length decreases during the late summer, eiders migrating to the molting area in darkness would be more likely to encounter vessels using high-intensity lights. Spectacled eiders often migrate at night and flying at night they can become disoriented by high-intensity work lights and strike vessels. Eiders flying during low-visibility conditions of rain or fog can also strike vessels.

The risk of collisions with spectacled eiders is lowest beyond 60 km offshore, because females tend to travel within 60 km and males travel within 35 km. Within these distances from shore, the risk of collisions might increase, especially during poor visibility. The greatest risk of a vessel strike would exist if the seismic-survey vessel was using high-intensity lighting while transiting through areas of high spectacled eider density at night during fog or rain.

The most likely effects of seismic surveys to Steller's eiders in the Beaufort and Chukchi seas involve the same type of disturbances and collisions associated with spectacled eiders. Due to the extent of sea ice, it is unlikely that seismic surveys would begin in the Beaufort Sea when males are passing through, so impacts to Steller's eiders are unlikely. Males could be encountered in the Chukchi Sea in the summer and fall, and females might be encountered in both the Beaufort and Chukchi seas during the seismic-survey period. Limited data exist on breeding Kittlitz's murrelets. Breeding pairs in the Chukchi Sea are solitary and nested well inland on the tundra. They forage at sea during nesting and chick rearing, but their foraging distances during this period in the Chukchi Sea are unknown. In glaciated areas in Alaska, they typically forage within a few hundred meters of shore. An estimated 15,000 Kittlitz's murrelets have been observed in the pelagic waters of the Chukchi Sea beginning in late August, but their presence is sporadic, suggesting there are additional factors that influence their distribution and that there is large interannual variation in abundance. Accordingly, the potential for disturbance from or collision with seismic-survey vessels or aircraft is small. It is possible, during the course of normal feeding or escape behavior that a murrelet could be near enough to an airgun to be injured by a pulse. A mitigation measure to "ramp up" airgun noise when seismic surveys begin can help disperse birds before harm occurs. During ongoing surveys, murrelets also are likely to hear the advance of the slow-moving survey vessel and associated airgun operations and move away.

T&E Marine Mammals

Alternative 1 (No Action) would not expose T&E marine mammals (bow head, fin, and humpback whales) in the project area to noise associated with seismic surveys and their associated support vessels (air and sea)..

Alternatives 3 through 6 are similar but have varying levels of protection for T&E marine mammals. This variation in protection primarily is in the noise level set as the shut-down criteria and monitoring that is required to effectively monitor that noise-level radii, or shut-down/exclusion zone.

While all alternatives other than the Alternative 1 (No-Action) meet the objectives of this environmental assessment, they also potentially could adversely affect bowhead whales and other marine mammals, principally through incidental harassment due to exposure to seismic survey noise. Possible harassment likely would be most pronounced if large feeding aggregations of whales, or cow/calf pairs of bowhead whales, are affected. Alternatives 3 through 6 have the potential for causing adverse but not significant impacts.

Alternatives 3 through 6 would prohibit seismic surveys around bowheads in the spring lead system and thereby reduce the potential for adverse effects of seismic surveys on bowhead calving, cow/calf pairs, and newborn calves. The effect of seismic surveys on these components of the population is very uncertain, and avoidance of their exposure is the most effective way to reduce the potential for an adverse effect on these bowheads. Even at a 120-dB isopleth shut-down zone (included in Alternatives 3 and 5), bowhead whales might still detect seismic survey airgun sounds, icebreaker sound, or vessels associated with seismic surveys.

Variability in the size and configuration of the airgun arrays, water depth, and bottom properties all can influence these noise-level radii, which is expected to vary from one location to another and between different seismic operations. Therefore, field verification is included as a mitigation measure to verify the actual noise-level radii. Shut-down or safety zones may be as large as 30 km for the 120-dB zones and as small as 100 m for the 190-dB zones, depending on the size and energy output of the airgun array and environmental conditions. It is likely that monitoring will be required using one or more of these: aerial surveys; passive acoustic monitoring; and boat-based surveys. If these methods of monitoring are not effective, then additional mitigation measures may be set in place (i.e., adaptive management schemes where specific areas of higher marine mammal concentrations are avoided on a temporal or spatial basis).

Alternatives 3 through 6 provide monitoring requirements meant for observers to visually monitor the exclusion zone, regardless of size, and be able to call for a shut down if marine mammals enter the exclusion zone. The ability of observers to effectively monitor the exclusion zone, and be able to call for a

shut down if bowheads enter the zone, is critical to the success of the protective measures described in Alternatives 3 through 6, although it is generally not possible to observe all bowheads within the exclusion zone, especially during foggy weather or at night. Additional monitoring techniques, such as aerial surveys, vessel-based systems, or passive acoustics, could enhance the ability to detect bowhead whales and other marine mammals in larger exclusion zones.

Evidence shows that bowhead whales and other cetaceans can react behaviorally in the presence of aircraft. The mitigations imposed under Alternatives 3 through 6 all would require that aircraft be flown no lower than 1,000 ft, a level that limits the potential for reactions from marine mammals. Therefore, the use of aerial over flights in monitoring would not be expected to add additional impacts to bowhead whales. The same is true for passive acoustic monitoring where observers simply "listen" for evidence of whale noise. Vessel-based monitoring may impose a degree of additional disturbance, but it would be considered less than what would occur for seismic activity should whales not be monitored but present in the exclusion zone.

Each exclusion zone in Alternatives 3 through 6 would require boat-based visual monitoring (i.e., all observers are scanning areas from the vessel as far as visually possible with appropriate equipment). The additional monitoring techniques (e.g. aerial or vessel-based surveys, acoustic monitoring) that may be necessary for Alternatives 3 and 5 could be costly to implement because the larger exclusion zone associated with the 120-dB isopleth, in theory, would provide a much larger and more difficult area to monitor then the smaller exclusion zones (160-dB isopleth and 180/190-dB isopleth). Smaller exclusion zones are less effective in limiting impacts to cetaceans than larger exclusion zones because larger exclusion zones associated with Alternatives 3 and 5 would by definition require further distance of operating seismic survey vessels from cetaceans than Alternatives 4 and 6. Additional mitigation measures would be set in place (i.e., adaptive management schemes where specific areas of higher marine mammal concentrations are avoided on a temporal or spatial basis) should monitoring measures prove ineffective. Therefore, the varying degrees of impact among the alternatives, as discussed in the paragraphs above, remains the same with the greatest to least level of protection from behavioral disturbance being Alternatives 3, 5, 4, and 6 respectively.

Non-T&E Marine Birds.

Murres. The chance of murres colliding with seismic-survey vessels is relatively low, because most murres should be out of the action area during the male molt and at-sea rearing period. The primary risk of collision occurs during the brief period when murres migrate south to the Bering Sea. Based on telemetry data, most murres would not migrate through the action area.

Puffins. Seismic-survey vessels would remain at least 3 mi from shore, so there is little chance for disturbance of breeding colonies. Most puffins are located near Cape Lisburne in September, but this area represents only a small portion of the action area, and it is possible that this area already might be surveyed prior to September. If surveys were completed prior to September, there would be minimal risk of puffins colliding with the seismic-survey vessel.

Black-legged Kittiwake. Disturbance and risk of collision should be minimal to kittiwakes, as they are mobile (i.e., not molting) and wide ranging throughout the Chukchi Sea. There are no discernable areas of concentration that may increase the impact of disturbance or risk of collision. Most kittiwakes are out of the Chukchi Sea by late September.

Northern Fulmar. If distribution trends are similar to the 1980's, most fulmars would be south of the action area. Furthermore, most fulmars are present in the Chukchi Sea for only a few weeks at the end of summer; it is possible that all survey vessels would be working on survey areas farther north during that time to take advantage of the period of maximum ice retreat in the Beaufort Sea. Both of these factors make the chance of large scale disturbance or collision minimal.

Short-tailed Shearwaters and Auklets. These species are considered together, because they occur in similar numbers and both forage on patchily distributed zooplankton in pelagic waters. The chance of disturbance

is low, because their distribution is patchy and the disturbance is of short duration. A disturbance might lead to a temporary halt in feeding in one area or a switch to a new and possibly less-productive area.

The risk of collisions is a more relevant issue, as shearwaters and auklets are present in the Chukchi Sea until late September or early October. There are about 12 hours of darkness during this period, and seismic surveys could occur 24 hours a day. Large collisions involving crested auklets and lights on commercial-fishing vessels have been documented. Collisions are not documented for shearwaters, but these types of events typically are poorly documented. It appears most likely that large collisions occur when a combination of darkness, fog, rain, or snow exist and high-intensity lights are used on commercial vessels near large aggregations of certain species of seabirds. While there is no certainty that collisions would occur, the chance seems to be the greatest for auklets and, perhaps to a lesser extent, shearwaters in the Chukchi Sea during seismic surveys.

Black Guillemot. These birds usually are closely associated with the ice edge, and the likelihood of disturbance or collisions is limited to a small portion of the action area. Seismic-survey vessels need to follow a specific course during the survey and, therefore, minimize surveys near the ice edge due to the presence of large sections of ice that could cause the vessel to alter course or damage seismic instruments. Accordingly, operations in areas likely to be inhabited by black guillemots are limited, and the chance for disturbance and collisions is minimal.

Gulls and Terns. The likelihood of impacts from disturbance or collisions to Ross' gulls, ivory gulls, arctic terns, and glaucous gulls is minimal. Ross's gulls and ivory gulls are associated with ice and breed well outside the action area. They are present in the action area for a short period before migrating through the Chukchi Sea to overwintering locations. Arctic terns breed near the coast of both seas, but seismic vessels will be operating beyond 3 mi from shore; therefore, disturbance is unlikely. Terns migrate through the Chukchi Sea but are rarely observed in pelagic waters. Similarly, glaucous gulls typically are most abundant within 70 km of shore, thereby reducing the likelihood of disturbance and collisions.

Phalaropes. Both species of phalaropes may be encountered in the Beaufort and Chukchi seas, especially during the postnesting period in late summer and fall. Phalaropes use habitat within a few meters of shore and also pelagic areas; their distribution is generally tied to patchy concentrations of zooplankton. Because seismic-survey vessels would remain at least 3 mi offshore, disturbance to or a collision with phalaropes nearshore is unlikely. In pelagic waters, disturbances may occur but their impact is likely to be minimal, due to the patchy distribution of prey and the transient and short-term nature of seismic surveys. Disturbed phalaropes might move to another prey patch or return to the same area after the disturbance passes. Collisions may occur, especially during inclement weather, but the likelihood of collisions is unknown. Red-necked phalaropes were attracted to lights on a ship in the Gulf of Guinea and reacted most strongly at night in inclement weather. There does not appear to be any other documented cases of collisions involving phalaropes, so the incidence of collisions may either be low or unreported.

Jaegers. The chance of impacts to jaegers by disturbance or collision is minimal. Although they are present throughout the Chukchi Sea in the fall when there are several hours of darkness and frequent inclement weather, jaegers are not known to occur in high concentrations in any area.

Loons. In the Beaufort and Chukchi seas, loons typically migrate close to shore until they are south of Cape Lisburne, when they travel over pelagic waters on their migration to wintering areas. Impacts from disturbances or collisions are unlikely, because loons migrate nearshore in most of the action area, and seismic-survey vessels would remain 3 mi offshore.

Long-Tailed Ducks. Impacts from disturbances or collisions are unlikely, because long-tailed ducks molt in lagoons on the coast of the Beaufort Sea. Seismic-survey vessels would remain 3 mi offshore during surveys. After molting, these birds move south following the Chukchi Sea coast and typically remain 45 km offshore along the 20-m isobath. Observations farther offshore are uncommon. The chance of disturbance is small due to the small portion of the action area within 45 km from the coast. Collisions are possible, especially in inclement weather.

Common Eider. Impacts to common eiders likely would be similar to those described for spectacled eiders, although the implications of potential impacts probably are less significant. Common eiders molt near several locations along the Alaska Chukchi Sea coast including Point Lay, Icy Cape, and Cape Lisburne. Like spectacled eiders, their molt locations probably coincide with areas of high-density prey items. Disturbance at molt locations could impose additional stress during this energetically demanding period; the degree of stress would depend on the magnitude and frequency of disturbance. Collisions are possible, especially during nighttime when there is inclement weather. Most common eiders follow the 20-m isobath, which is ~45 km from shore in the Chukchi Sea and 13-16 km in the Beaufort Sea. Because most of the action area lies well beyond these distances form shore, eiders are at risk of collisions for a small portion of the surveys. Implementation of mitigation measures would reduce the likelihood of collisions.

King Eider. Impacts would be similar to common eiders in both the Beaufort and Chukchi seas, except that king eiders molt at locations in the Bering Sea. Migration distances from shore are similar, so the collision impacts are likely similar to common eiders.

Non-T&E Marine Mammals.

The most likely effects on marine mammals from seismic activity and the proposed alternatives include disturbance reactions to seismic vessels and associated aircraft traffic, and altered prey availability. Responses, such as fright, avoidance, and changes in behavior and vocalization patterns have been observed in marine mammals at ranges of tens to hundreds of kilometers from a sound source. Sound could also affect marine mammals indirectly by changing the accessibility of their prey species. Populations could be adversely affected if feeding, orientation, hazard avoidance, migration, or social behaviors are altered. Serious long-term consequences could also result from chronic exposure. Baleen whales (bowhead, fin, humpback, gray, and minke whales) are the most sensitive marine mammal species to anthropogenic noise in the action area.

The No Action alternative (Alternative 1) would not expose marine mammals in the project area to noise associated with seismic surveys and their associated support vessels (air and sea). Other methods to collect geophysical and geological data (as yet undetermined) may disturb animals in the project area in unknown, but possibly similar ways.

Alternatives 3 through 6 are essentially the same with varying levels of protection for marine mammals depending on the size of an exclusion zone and related monitoring. They all are environmentally sound, as they all contain protective measures to mitigate possible impacts on marine mammals. Theoretically, when effectively monitored, alternatives with the lowest dB isopleth exclusion zone (e.g., Alternative 3 at 120-dB) provide a greater level of protection for marine mammals from harm and harassment than those alternatives having a higher dB isopleth exclusion zone (e.g. Alternative 6 at 180/190-dB). In addition, Alternatives 3 through 6 would prohibit seismic surveys around marine mammals in the spring lead system.

Field verification of the exclusion zone would be required under these alternatives, and the appropriate size of the exclusion zone would be based on these results. It is likely that the exclusion zone for these bigger arrays would be larger than what has been previously used, and this may result in an increased area where marine mammals may be harassed. In addition, as the safety zone increases in size (from 190/180-dB to 120 dB; Alternatives 3 through 6), the ability of vessel-based visual observers to effectively monitor the exclusion zone decreases. Therefore, additional monitoring techniques (i.e., aerial surveys and acoustic monitoring) or mitigation measures would be required for the alternatives with larger exclusion zones.

Pinnipeds (Ringed, Spotted, Ribbon, and Bearded Seal and Pacific Walrus). The NMFS' current Level A harassment threshold for pinnipeds (excluding the pacific walrus) is 190 dB. Pacific walrus are managed by the FWS, and they recently implemented a 180-dB exclusion zone for walrus.

Alternatives 3 through 6 all provide exclusion zones capable of providing protection for pinnipeds in the project area. The exclusion zone would be the smallest for Alternative 6 (180/190 dB) and could be monitored visually by vessel-based observers. Conversely, Alternative 3 would provide the largest exclusion zone (120 dB). Increased disturbance from vessel and aircraft activity could consequently cause

pinnipeds to leave haul-out locations and enter the water, though the response is highly variable. This could have a greater impact if flushing of haul out sites occurs when pups are present, as they can be more easily injured and separated from their mothers. Use of the 160 dB exclusion zone in Alternative 4 and in Alternative 5 would provide an intermediate-sized safety zone. Alternatives 3-5, when properly monitored, would provide exclusion zones which are sufficient for pinnipeds.

The MMS believes the potential for any injuries to pinnipeds from the proposed activity and Alternatives 3 through 6 is very limited, with Alternative 6 providing a slightly greater potential for Level A Harassment as its specified exclusion zone of 190 dB most closely approaches the lower limits of levels set by NMFS for Level A Harassment.

Alternatives 3 through 6 require trained observers to visually monitor the exclusion zone, regardless of its size, and to be able to call for a shut-down if pinnipeds enter the exclusion zone. The ability of observers to effectively monitor the exclusion zone, and be able to call for a shut-down if pinnipeds enter the zone is critical to the success of the protective measures described in Alternatives 3 through 6, though it is often difficult to observe all pinnipeds within the exclusion zone.

Pinnipeds are not likely to be exposed to sound levels which could cause injury, as they would have to swim within extremely close proximity to the seismic array in order to be vulnerable, and there is no specific evidence that exposure to pulses of airgun sound can cause direct injury to pinnipeds. The most likely potential impacts to pinnipeds from seismic surveys and associated activities would be disturbance and possible impacts to food resources.

Alternatives 3 through 6 would require overflights at or above 1,000 ft in order to minimize the potential for behavioral impacts to marine mammals. Therefore, the use of aerial surveys is not expected to significantly increase the potential for harassment of pinnipeds. Therefore, the varying degrees of impact between the alternatives remains the same with the greatest to least level of protection from behavioral disturbance and injury being Alternatives 3, 5, 4, and 6 respectively.

Cetaceans (Beluga Whale, Killer Whale, Harbor Porpoise, Minke Whale, and Gray Whale). NMFS' current threshold for Level A Harassment (potential to injure) of cetaceans is 180 dB. The mitigation measures outlined in Section IV, and which apply to Alternatives 3 through 6, are set to avoid any takes of marine mammals by Level A Harassment. In addition, the MMPA authorization required under Alternatives 3 through 6 would not authorize any Level A takes of marine mammals. Based on the above, the fact that no injuries to marine mammals have been documented from seismic survey activities, MMS believes the potential for any injuries to cetaceans from the proposed activity and Alternatives 3 through 6 is very limited, with Alternative 6 providing a slightly greater potential for Level A Harassment as its specified exclusion zone of 180 dB most closely approaches the lower limits of levels set by NMFS for Level A Harassment.

The NMFS' current threshold for Level B Harassment (potential to disturb) for cetaceans is 160 dB. No studies have shown that toothed whales have reacted behaviorally to seismic sound below the 160 dB received sound level. Studies on most baleen whales, except for the bowhead and gray whale, have also not demonstrated behavioral reaction at a received sound level of less than 160 dB. However, data exists showing that gray and bowhead whales may react behaviorally at received sound levels lower than 160 dB. In comparing Alternatives 3 through 6, looking purely at the size of the exclusion zone and assuming the monitoring requirements will be effective, there are differences in the level of potential behavioral impact across these alternatives. The most protective (i.e., resulting in the least potential for takes by Level B Harassment and avoidance of Level A Harassment) would be Alternative 3 as this provides the largest exclusion zone (120 dB) and would apply for all marine mammals. Given the bowhead whale is the only cetacean in the Proposed Action area to show avoidance near the 120 dB received sound levels from impulse sounds and all other cetaceans in the Proposed Action area have generally demonstrated avoidance at higher received sound levels (i.e., 160 to 180 dB), Alternative 3 would result in the least impact to cetaceans and other marine mammals in the Proposed Action area.

After Alternative 3, Alternative 5 would provide the next most protective level for cetaceans. In this alternative, the exclusion zone would be set at 160 dB unless a certain number of bowhead whales (individuals, reproductive-age females, calves) were present, as determined by MMS and NMFS, where the exclusion zone would be changed to 120 dB. The combination of the two exclusion zones under this alternative would provide all cetaceans with additional protective measures but still would provide an exclusion zone at 160 dB (the level set by NMFS beyond which Level B Harassment is more likely to occur) at all remaining times. Therefore, Alternative 5 provides the next most protective alternative for marine mammals.

Alternative 4 follows Alternatives 3 and 5, respectively, in the degree of potential impacts to cetaceans. This alternative sets the exclusion zone at 160 dB at all times, the level set by NMFS beyond which Level B Harassment is more likely to occur. Therefore, the greatest potential for Level B Harassment exists for Alternative 6 where the exclusion zone for cetaceans is set at 180 dB, which exceeds NMFS' 160 dB determination for Level B Harassment (disturbance) and most closely approaches the NMFS determination for Level A Harassment (injury).

While the additional techniques required for Alternatives 3 and 5 would be costly and a larger exclusion zone in theory would provide a much larger, and possibly more difficult, area to monitor, this does not necessarily mean these larger exclusion zones are less effective in limiting impacts to cetaceans for the following reasons: (1) each exclusion zone in Alternatives 3 through 6 would require boat-based visual monitoring (i.e., all observers are scanning areas from the vessel as far as visually possible with appropriate equipment); (2) larger exclusion zones in Alternatives 3 and 5 would by definition require further distance of operating seismic vessels from cetaceans than Alternatives 4 and 6 with smaller exclusion zones; (3) the aerial survey and acoustic monitoring required in Alternatives 3 and 5 (and not in Alternatives 4 and 6) would provide additional coverage further away from the seismic source; and (4) additional mitigation measures would be set in place (i.e., adaptive management schemes where specific areas of higher marine mammal concentrations are avoided on a temporal or spatial basis) should monitoring measures prove ineffective. Therefore, the varying degrees of impact between the alternatives, as discussed in the paragraphs above, remains the same with the greatest to least level of protection from behavioral disturbance being Alternatives 3, 5, 4, and 6 respectively.

Marine Fissipeds (Polar Bear). Polar bears are managed by the FWS, and they recently implemented a safety radius for polar bears of 190 dB (USDOI, FWS, 2005). Because any polar bears encountered will most likely be on the ice, air gun effects on them are expected to be minor. If polar bears are encountered in the water, received sound levels would be substantially reduced due to the pressure release effects near the water surface (Richardson et al. 1995a). The most likely impacts to polar bears from seismic surveys and associated activities would be disturbance and possible impacts to bears' food resources. Any impacts of seismic activity to polar bear food resources will probably be minor, local and brief in nature. Bearded and ringed seals are the primary prey of polar bears in the action area, and abundance and availability of these seals are not expected to be significantly altered by the proposed seismic surveys and associated activities.

Alternative 6 provides the smallest exclusion zone (180/190 dB) and could be visually monitored by vessel-based observers. As the exclusion zones grow in size, it becomes less likely that the zone can be effectively monitored by vessel-based observers and aircraft-based observers will need to be added (i.e., when 120-dB level is used in Alternatives 3 and 5). Vessel activity should cause only a brief disturbance, with bears resuming normal activities after the vessel passes. Aircraft activity may be more problematic as polar bears often run away from aircraft passing at low altitude (e.g., altitude < 200 m and lateral distance < 400 m). The inclusion of aircraft-based observers has the potential to disturb more polar bears than vessel-based observers alone if the aerial observations are flown at a sufficiently low altitude. Use of the 160-dB exclusion zone in Alternative 4 and in Alternative 5 will provide an intermediate-sized safety zone. For the Chukchi Sea, Alternatives 4 and 5 are essentially identical. The ability of observers to effectively monitor the exclusion zone, and be able to call for a shut-down if polar bears enter the safety zone is critical to the success of the protective measures described in Alternatives 3 through 6.

Subsistence-Harvest Patterns

Because no seismic activity would occur under Alternative 1, no impacts to subsistence resources and practices would be expected.

Alternatives 3, 4, 5, and 6 all would have similar impacts on subsistence harvests. Seismic surveys for prelease geophysical exploration activities would be permitted with existing Alaska OCS exploration stipulations and guidelines and additional specific protective measures for marine mammals, including an isopleth-specified exclusion zone. These alternatives would permit seismic surveys in the Beaufort and Chukchi seas and incorporate standard G&G-permit stipulations and additional protective measures to ensure that fish, wildlife, and subsistence-harvest resources and practices are not adversely impacted. An inability to effectively perform mitigation measures would result in the suspension of a G&G permit until such time that the protective measures can be successfully performed and demonstrated. Theoretically, the larger the exclusion zone coupled with shut-down procedures, the greater protection of marine mammals from potential harassment and injury. Therefore, the 120-dB isopleth-exclusion zone would afford more protection from harassment and injury for marine mammals than the 180/190-dB isopleth-exclusion zone. The more marine mammals are protected, the more subsistence-harvest activities are protected.

An operator could propose to conduct seismic-survey activity in an area critical to whaling during the whaling season; however, if this condition did occur, potential conflict could be mitigated by the cessation of activities during the whale migration. Because fall ice conditions are not predictable events, user conflicts between vessels and whalers due to bad ice conditions might be more difficult to mitigate. Presently, individual companies are coordinating with the whalers through the auspices of the AEWC. Such coordination was a requirement under MMS leases for Beaufort and Chukchi Sea Sales 97,109, 144, 170, 186, and 195. The working protocol is for the company to submit a plan of cooperation as a part of their exploration plan. Seismic surveying requires submission of a letter stating that cooperation will occur.

Required mitigation similar to the lease-specific Stipulations No. 4 - Industry Site-Specific Bowhead Whale-Monitoring Program and Stipulation No. 5 - Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence Activities and conflict avoidance measures defined in an IHA would specify any noise-monitoring program for marine mammals required for ongoing seismic operations in the Chukchi Sea and would be considered through the Peer Review Workshop meetings. Because permittees usually seek a Letter of Authorization (LOA) or IHA for incidental take from the NMFS, the monitoring program and review process required under the LOA or IHA generally will satisfy the requirements of Stipulations 4 and 5. Any potential monitoring program would be designed to: (1) assess when bowhead and beluga whales, walrus, and bearded seals are present in the vicinity of potential operations and the extent of behavioral effects on these species due to operations; (2) consider the potential scope and extent of impacts that the particular type of operation could have on these species; and (3) address local subsistence hunters' concerns and integrate Inupiat traditional knowledge.

Stipulations and required mitigation and conflict avoidance measures under MMP authorization as defined by NMFS and FWS should be followed in locations where the subsistence hunt is affected. The MMPA authorization obligates operators to demonstrate no unmitigable adverse impacts on subsistence practices. Conflict avoidance agreements between Permittees and the AEWC work toward avoiding unreasonable conflicts and disturbances to hunters and bowhead whales. Similar avoidance measures could be required for the subsistence beluga whale hunt by the Alaska Beluga Whale Committee (ABWC), for the subsistence walrus hunt by the Alaska Eskimo Walrus Commission (EWC), and for the subsistence polar bear harvest by the Nanuk Commission (NC). Such conflict avoidance agreements likely would follow protocols similar to those reached annually between Permittees and the AEWC for the subsistence bowhead hunt and address industry seismic-vessel activities under provisions of the MMPA. The AEWC prefers to negotiate a conflict avoidance agreement with industry on an annual basis using a regional rather than a project-specific approach, so as to address potential impacts from all ongoing projects. With the use of the conflict avoidance agreement methodology, Native subsistence-whale hunters generally have been successful in reaching their annual whale "take" quotas.

For MMS-permitted seismic surveys, NMFS- and FWS-sanctioned observers, usually local Alaskan Natives and biologists employed by the monitoring contractor, are onboard survey vessels. These

observers stop seismic operations when they observe marine mammals within the safety radius designated by the NMFS. Shut down of the airguns occurs if marine mammals are within this radius because of concern about possible effects on marine mammal hearing sensitivity (USDOI, MMS, 2003a).

Sociocultural Environment

Because no seismic-survey activity would occur (Alternative 1), no impacts to subsistence resources and practices and consequent impacts on sociocultural systems would be expected. However, if other nonseismic field techniques are proposed to be used, they would require additional environmental analysis.

Seismic surveys for geophysical exploration activities covered in Alternatives 3, 4, 5, and 6 would be permitted with existing Alaska OCS exploration stipulations and guidelines and additional specific protective measures, including a specified isopleth-exclusion zone (either 120 dB, 160 dB, 120 dB and 160 dB, or 180/190 dB). Additional protective measures (beyond the existing Alaska OCS exploration stipulations and guidelines) would be identified and incorporated into these alternatives to ensure that fish, wildlife, and subsistence-harvest resources and practices are not adversely impacted. An inability to effectively perform mitigation measures will result in the suspension of a G&G permit until such time that the protective measures can be successfully performed and demonstrated.

Avoidance planning, stipulations and required mitigation, and conflict avoidance measures under MMPA authorization are defined by NMFS and FWS and made a part of each alternative would serve collectively to mitigate disturbance effects on Native lifestyles and subsistence practices and would likely mitigate any consequent impacts on sociocultural systems.

To ensure compliance with the MMPA, MMS also is requiring seismic-survey operators to obtain from NMFS and FWS an Incidental Take Authorization (ITA), which could be in the form of an IHA or LOA, before commencing MMS-permitted seismic-survey activities. The ITA's mitigation and monitoring requirements would further ensure that impacts to marine mammals will be negligible and that there will be no unmitigable adverse impact on subsistence uses of marine mammals.

To achieve this standard, the seismic operators usually negotiate a Conflict Avoidance Agreement (CAA) with the Alaska Eskimo Whaling Commission and the affected villages' Whaling Captains Association. The CAA likely will include a prohibition on conducting seismic surveys during the bowhead whale-hunting season in the Beaufort Sea, describe a dispute-resolution process, and provide emergency assistance to whalers at sea. Implementation of the CAA further ensures that there will not be significant social or economic impacts on the coastal inhabitants of the Beaufort and Chukchi seas by avoiding an adverse impact on subsistence marine mammal-harvest activities.

Archaeological Resources

Alternatives 3 through 6 include potential use of ocean bottom cable (OBC) surveys to gather seismic data. The OBC surveys might occur in the Beaufort Sea but are not anticipated to occur in the Chukchi OCS because of its great water depths and the greater efficiency of streamer operations in deep water.

The OBC seismic surveys potentially could impact both prehistoric and historic archaeological resources in waters inshore of the 20-m isobath or in deeper water, if cables are laid from shallow to deep water. Assuming compliance with existing Federal, State, and local archaeological regulations and policies and the application of MMS' G&G Permit Stipulation 6 (regarding the discovery of archaeological resources) and CFR 251.6 (a)(5) regarding G&G Explorations of the Outer Continental Shelf to not "disturb archaeological resources," most impacts to archaeological resources in shallow offshore waters would be avoided.

Environmental Justice

Because no seismic survey activity would occur under Alternative 1 (No Action), no environmental justice impacts would be expected.

Inupiat Natives could be disproportionately affected by any alternative that allows seismic because of their reliance on subsistence foods; and actions under these alternatives could affect subsistence resources and harvest practices. Avoidance planning, stipulations and required mitigation, and conflict avoidance measures under IHA requirements as defined by NMFS and FWS and made a part of each alternative would serve collectively to mitigate disturbance effects on environmental justice. Mitigating measures likely would incorporate traditional knowledge and the cooperative efforts between MMS, the State, the people of the North Slope, and tribal and local governments. With required mitigation and conflict avoidance measures in place, significant impacts to subsistence resources and hunts would not occur as a result of this action, thereby avoiding significant impacts on sociocultural systems and disproportionately high adverse impacts on low income and minority populations in the region.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.